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AUTHOR Lewis, Raymond J.; Wall, Milan
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ABSTRACT

A discussion of the role of technology in teaching and learning in higher education focuses on obstacles to the successful infusion of information technologies in the classroom. It comes at a time when colleges and universities are poised for a giant leap forward into a variety of new technologies, a situation brought on by increasing societal pressure and continued advances in technology. Colleges and universities are faced with keeping pace with a technological revolution of mammoth proportions, but the pace of introduction of various technologies has moved slowly despite the increasing proliferation on the market of computing, audio, video, and such interactive technologies as videodisc and two-way audio-video systems. The role of information technology in higher education is discussed in terms of historical perspectives, and reasons for using or not using technology. Information on the obstacles to appropriate and effective instructional use of information technologies is presented in relation to on-campus learning (technical, structural, and attitudinal obstacles) and distance learning (with the same obstacles). Despite various complex, interrelated obstacles to technology use there are signs of genuine progress in the development of varying uses of technology in colleges and universities. It is time to encourage strategies to pilot developments, expand existing usages, and cooperate with the private sector in order to embrace the profit motive and the goals of education. (SM)

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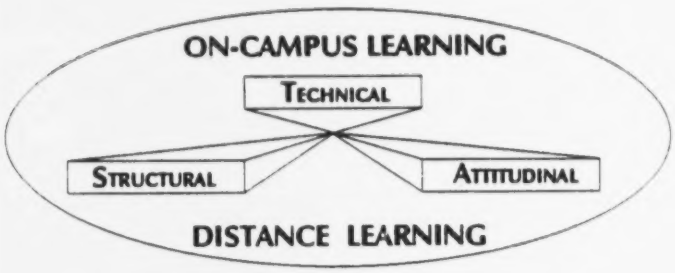

A Discussion Paper

Technology in Higher Education: A Round Table
December 6-7, 1988

Prepared by

Raymond J. Lewis
Director, Learning and Technology Services
Portland, Oregon

and

Milan Wall
Co-Director, Heartland Center for Leadership Development
and
Executive Director, Nebraska Center for Excellence in Education
Lincoln, Nebraska

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INTRODUCTION

Colleges and universities today are faced with the challenge of keeping pace with a technological revolution of mammoth proportions. Increasingly, the young people who enter higher education as undergraduates come from homes and schools where technologies of various kinds constitute a dominating force. At the same time, colleges and universities are sending recent graduates into the world of work (from the office to the plant to the laboratory)--a world that is becoming technology-intensive at an even greater speed.

■ *Colleges and universities seem poised for a giant leap forward into a variety of new technologies.*

The quick pace of technological intervention also is found in the administrative and service departments of higher education, where computing for accounting, purchasing, recordkeeping, and research is an every-day practice.

On the instructional side, the pace of introduction of various technologies has moved considerably slower, despite an increasing proliferation in the marketplace of computing, audio, video, and now interactive technologies, such as videodisc and two-way audio-video systems.

Although college and university instructors have experimented with information technologies for decades, the typical college professor still teaches in the manner of academicians dating back hundreds of years. Those instructors who venture into technology have often been dissatisfied with their experiences. There remains widespread skepticism on campuses stemming from the historical failure of technological interventions such as closed circuit television.

More recently, the relative lack of high-quality instructional software for computers has reenforced this skeptical view. The promise of videodisc and other interactive technologies to revolutionize teaching and learning (a promise as yet unfulfilled) creates an atmosphere of non-performance that provides yet another opportunity for faculty and critics to make excuses for the relative absence of technologies in America's college classrooms.

This paper constitutes a starting point for discussion about the role of technology in teaching and learning in higher education and focuses specifically on obstacles to the successful infusion of information technologies into the classroom. It is written at a time when colleges and universities seem poised for a giant leap forward into a variety of new technologies, a situation brought on by increasing societal pressure and the continued advances in technology.

Nevertheless, in some institutions where historical resistance to technology has prevailed, planners and administrators have avoided serious mistakes which have saddled the more enthusiastic schools with outmoded or underutilized technologies.

The reverse side of that coin shows that no institution can afford to do ***nothing***. The technologies will continue to evolve; there is no point in time where an institution can become involved in technology with any assurance that, over time, their acquisitions too, will *not* become outmoded.

For reluctant institutions, the answer may be a simple matter of careful planning and starting small--a pilot project here and there to test the waters and gain experience.

■ *In the world of technological innovation, education has a long way to go.*

THE ROLE OF INFORMATION TECHNOLOGY IN HIGHER EDUCATION

Historical Perspectives

Fully integrating information technologies into higher education is a very difficult challenge (some educators would describe it as nearly impossible). Technology advocates and skeptics alike can point to almost 40 years of obvious discrepancies between promises and practices. The pace of technological activity in the last decade on college campuses has increased; however, and for that reason and others, the promises remain very much alive. Still, the anticipated match between technology and learning remains highly elusive.

Perhaps those who are impatient with the pace of change in higher education need to remind themselves that it took educators hundreds of years to learn how to make effective use of the printed word, and some maintain that improvement is still needed in the use of ink and paper, even though the textbook by now can be considered a ***mature technology***. However, the demands on education today suggest that it will not have the luxury of additional hundreds of years to learn how to integrate computer, video, and audio technologies into academic instruction. Nevertheless, the challenges remain complex and the roadblocks significant. In the world of technological innovation, education has a long way to go.

Reasons for Using Technology

An examination of obstacles to the use of technology in academic instruction should start with a consideration of the reasons for turning to information technologies in the first place. When college faculty members are asked what role information technologies should play in instruction, there is nearly universal agreement that these innovations should be seen as *supplements* to traditional instruction, not replacements or duplicates of what the teacher can do in the classroom.

■ *Innovations should be seen as supplements to traditional instruction.*

Faculty members often cite one or more of the following reasons for using technologies in their teaching:

To accomplish tasks that they cannot do by themselves, such as help students experience times, places, people, and events that cannot be otherwise incorporated into the class.

To accomplish tasks better than they can by themselves, such as help students visualize phenomena that are too small or too dynamic to convey effectively with print or static models or hand waving.

To perform routine teaching tasks which instructors can do but prefer not to, such as helping students overcome individual learning differences through drill and practice.

To prepare students for the world of work, such as how to use and apply spreadsheet, word processing, or computer-aided design technologies.

To enhance faculty and/or student productivity, thereby reducing time required for routine recordkeeping or communication, such as writing or revising or specific teaching or learning styles.

To reach, via distance, learning those students who chose not or are unable to attend classes on campus in the conventional manner.

Reasons for Not Using Technology

Technology is, of course, not always the solution. In fact, if used inappropriately, it may become a roadblock to effective learning.

Listed below are some of the reasons often cited for not using information technologies for instruction:

When the technology is inappropriate to the educational task, such as using low production-value, pre-recorded video to convey basic course content to under-motivated students.

When the technology cannot be effectively employed, such as when a classroom has not been adequately wired for an audio or video transmission.

When the technology cannot be afforded, such as insufficient access to computers to justify making major class assignments involving computer applications to all students.

When a combination of faculty skills and existing print materials are able to convey course content effectively to all students in a specific course.

■ *One of the most formidable challenges to the integration of information technologies into higher education is the rapid pace of technological change.*

OBSTACLES TO APPROPRIATE AND EFFECTIVE INSTRUCTIONAL USE OF INFORMATION TECHNOLOGIES

Because of the widely different needs between time- and place-dependent learning and learning where time and place are variable, the discussion of obstacles has been divided into two sections: ***On-Campus Learning*** and ***Distance Learning***. Within each section, obstacles are examined according to three categories: ***technical***, ***structural*** and ***attitudinal***. In many ways, these obstacles overlap: to an increasing extent, the difficulties faced in on-campus and distance-learning situations are becoming similar. At the same time, the lines between on- and off-campus students are beginning to blur as students move back and forth between on-campus and distance learning courses.

On-Campus Learning

Technical Obstacles

One of the most formidable challenges to the integration of information technologies into higher education is the rapid pace of

technological change and, increasingly, the complexity associated with combining technologies. If money were no object, it would still be difficult to make intelligent decisions about the acquisition and use of computers and telecommunications technologies. When budgets are tight, as is the case at most colleges and universities, costly mistakes can be disastrous, with effects felt for years into the future.

With this constraint in mind, listed below are the major technical obstacles facing colleges in on-campus use of information technologies.

■ *The policies and procedures of colleges and universities themselves are often major obstacles to instructional uses of technologies.*

Incompatibility or lack of industry-wide standards constitutes perhaps the greatest technical obstacle, as colleges and universities struggle to interpret a wide variety of hardware and software designs. This problem is exacerbated by the multitude of potential administrative, research, and instructional applications possible on a single campus or within a multi-campus system. It is further complicated by the proliferation of different types of technology, such as the wide variety of personal computers found on campuses where purchasing decisions are decentralized and campus standards for support services have yet to be set.

The complex and unfriendly nature of both hardware and software also has been a major hindrance to instructional uses. This situation now appears to be improving, but narrow interpretations, vendor self-interest, and the pace of technological change are working against early resolution of these barriers.

Lack of high-quality software and instructional materials remains a serious deterrent to adoption of technological innovations despite the rapidly increasing proliferation of materials on the market. Unfortunately, much of the current material still suffers from poor instructional design and/or weak content.

Difficulty in adapting to specific teaching requirements is another roadblock to faculty adoption of technology. Issues of format, copyright, accessibility, and price loom large in the faculty assessment of what constitutes acceptable academic software.

Structural Obstacles

The policies and procedures of colleges and universities themselves are often major obstacles to instructional uses of technologies. Some are guilty of sins of both omission and commission.

Budgeting Policies. Institutional budgeting policies and practices often frustrate efforts to make the substantial up-front investments required to buy or lease expensive hardware. Departmental budgets are often inadequate to support acquisition and upkeep of computers needed for instructional purposes.

More fundamental questions, however, face those who control the budget. Are the traditional budgeting policies based on enrollment levels adequate if technology pervades all parts of the institution? How shall the technology resources be managed and what kind of needed support system for the uses of technology will be required and administered?

Lack of Incentives. Lack of faculty incentives and rewards for improvement in teaching is a pervasive obstacle to technology use. The tasks of learning to use computer, video, or audio technologies require considerable time. Without such incentives as released time, scheduling adjustments, or mini-grants, most faculty members find it more rewarding to focus their attention on research and writing in the traditional sense.

■ *How shall the technology resources be managed and what kind of needed support system for the uses of technology will be required and administered?*

Lack of Training or Technical Support. By far the greatest problem facing institutions desiring widespread use of technology is training people at various levels to be able to use the technological resources. Instructors, administrators, staff, and students need to be trained to use the systems and equipment. In addition, adequate technical support and service systems for equipment maintenance and repair need to be provided.

Poor Support Services. Without adequate support services and meaningful training programs, even a highly motivated faculty member finds using technology a frustrating experience. Critical support services fall into the following categories:

- Information about hardware and software
- Evaluation of hardware and software
- Demonstrations of hardware and software
- Training and technical assistance for faculty and student user
- Maintenance and repair of equipment
- Communication with current and potential vendors
- Acquisition and cataloging of software and programming materials
- Establishing and documenting institutional standards and procedures for software and hardware use.
- Distribution of equipment and supplies (initially and on a continuing basis).

The experiences of more technology-intensive institutions indicate that variations of all these support services are needed to integrate technology into instruction effectively. The failure to provide academic users with these services, even on a modest scale, can undermine an institution's efforts to encourage more use of technology.

Software Development. An even higher level of support is needed on those campuses where faculty members are expected to develop as well as to use technologies. The challenge of adapting or developing software is considerable, and faculty members need the help of skilled programmers and instructional designers to play this role successfully. Without such assistance, only a small minority of motivated and technically skilled teachers will produce useful instructional resources.

Financial Resources. Many colleges and universities lack the financial resources necessary to provide adequate hardware, software, or support services. Smaller and less affluent colleges and universities have a difficult time competing with larger, wealthier, and more prestigious institutions. In addition, vendor generosity often rewards the latter group disproportionately.

■ *It is difficult to have much impact on the teaching and learning process if a college cannot provide its students and faculty members with convenient access to the technology.*

Access. It is difficult to have much impact on the teaching and learning process if a college cannot provide its students and faculty members with convenient access to the technology. For example, until there are sufficient numbers of computers available, faculty members will be reluctant to make class assignments that require access to them. Colleges that are unable to provide a sufficient computer-intensive environment may find themselves relegated to a second-class status compared to wealthier institutions. The consequences of such inequities may have a negative rippling effect on recruitment of faculty members and students.

Logistical Annoyances. Some of the obstacles can be traced to what appear to be relatively minor annoyances which, left unresolved, can build into major barriers. Among them are logistics, turf battles, and even security systems.

Most college teachers have at least one war story to relate about pushing an audiovisual cart between buildings during a snowstorm or about arranging for a video or computer demonstration that fails to work properly. A faculty member who discovers that the wrong equipment has been delivered or who cannot make the software work is not likely to forget the embarrassment or the awkwardness of the situation for some time.

A student or teacher may find a computer lab inaccessible or unavailable due to security practices that close off campus buildings at certain times of the day or week, or that limit access to users with certain prescribed clearances. The rationale for the security measure may be understandable, the purposes laudable, but the result may be more frustration for students and faculty members who are locked out.

Disproportionate Access. Disagreement over who controls placement of hardware, scheduling of facilities, or selection of software also may lead to problems that students and faculty members find

they can do little to resolve. When a computer lab belonging to the math department sits underutilized while English or economics students cool their heels in long lines, struggles over who has what authority are a near-certainty. Moreover, much of what is written about computers (including the manuals) can more easily be read by scientists and engineers. As the social scientists and humanists expand their uses of the technologies, the disproportionate access issue will grow.

Extra Time Required. Most faculty members report that using technology generally takes more of their time than teaching by conventional methods. This is particularly true for instructors who develop their own software or programming materials. Faculty members who are developing software almost universally report that they are devoting substantial blocks of time for which they receive no additional compensation.

■ *The attitudes that hinder technology use should be familiar because most people share them to some degree.*

Underutilization. Many campuses have installed networks of varying kinds including voice, video, and data interconnection. Often their uses are restricted to small divisions of the institution. Sometimes, too, ignorance of the existence of the technology resources on campus inhibits more widespread development and usage.

Attitudinal Obstacles

The attitudes that hinder technology use should be familiar because most people share them to some degree. Apprehension about change, fear of technically complex devices, concerns about job security, resistance to being in the learning mode, worry that students are too uncomfortable with new devices, skepticism about claims made in the name of technology, and previous negative experiences are among the many attitudes that slow the pace of technological advancement in academia.

Fortunately, even academicians change their views over time. No less fortunately, some aspects of the technology also become friendlier over time, as users become more familiar with them and as hardware and software designers make new advances to create user-friendly machines and programs.

Mechanistic Focus. In any organization faced with decisions about the introduction of new technology, it is easy to focus almost exclusively on the hardware components. While the hardware may be expensive and even flashy, the users ultimately determine how effectively the equipment is used.

An institutional bias toward mechanistic innovation, without a companion commitment to teach users how to use the equipment and to supply related support services, is an attitude that can create roadblocks to effective use of the investment made in equipment, machinery,and space. Further, a lack of any organized, systematic, and integrated approach can turn over decisionmaking to people who do not enjoy a comprehensive, organizational perspective.

Faculty Resistance. How campus administrators spend technology budgets is not the only attitudinal impediment to effective adaptation to information technologies. Faculty members themselves are often the creators of significant obstacles through their own intransigence, ignorance,or bias related to technology and its uses. In addition, many faculty members have had quite real, highly frustrating experiences that enable them to point to past disappointments as good reasons for current resistance.

■ An institutional bias toward mechanistic innovation, without a companion commitment to teach users how to use the equipment and to supply related support services, is an attitude that can create roadblocks...

There are many reasons why faculty members resist such changes. Specifically, faculty feel that adopting technological approaches:

- Interferes with student-faculty communications by getting in the way and taking up too much class time.
- Requires too much prior planning.
- Involves working in collaboration with technicians and instructional designers rather than working alone.
- Requires too much time to learn to be proficient.
- Disrupts the traditional faculty authority role by forcing faculty to deal with matters outside their particular expertise.
- Removes from faculty members their control of their intellectual property as their course is transferred to video or some other technology.
- Threatens faculty jobs as administrators try to substitute technology for conventional teaching modes.

Distance Learning

The concept of learning that occurs between instructors and students separated by distances is probably as old as the practice of letter writing. Correspondence instruction is a more formalized

version of this learning process. As new technologies have emerged, radio, phonograph records, television, video- and audiotapes, computers, and other developing technologies have been integrated with print materials to facilitate teaching and learning across distances.

Historically, distance learning has been at the periphery of American education. In recent decades, it has been gradually winning acceptance as a tool for filling in the gaps in our otherwise comprehensive educational system. The proliferation of information technologies has made it easier to use distance learning techniques to meet the needs of time- and place-bound adults, as well as youth in smaller and rural high schools that lack sufficient capacity or training.

■ *Proliferation of information technologies has made it easier to use distance learning techniques to meet the needs of time- and place-bound adults, as well as youth in smaller and rural high schools.*

As information technologies make time and place less relevant variables in the educational process, the lines between traditional campus-based learning and distance learning are likely to blur. As more local, state, and national governments strive to meet their dual commitments to access and to quality, they are likely to take growing interest in encouraging distance learning. Overcoming obstacles to distance learning will be an important part of this movement.

Technical Obstacles

Distance learning has two inherent problems: *providing the student with sufficient educational resources* and *providing timely feedback from the teacher to the student*. Information technologies can help overcome both of these problems. Unfortunately, there are some factors that hinder effective use of these technologies for this purpose.

Pace of Change. The rapid pace of technological change acts as a double-edged sword for those organizations and institutions that want to implement distance learning systems. It is difficult to design a local, regional, statewide, or multi-state delivery system that takes advantage of current technological capabilities and yet is not in danger of becoming obsolete in the near future. Knowing that this problem "goes with the territory" does not end the frustration.

Inequitable Access to Telephone Service. Although satellite-delivered video and audio lessons, computer mail, and conventional postal services can be used to reach virtually anyone in the United States, rural learners may not have equitable access. Why? Because the capacity of the new technologies to help solve the problems of isolated learners is hindered by inadequate and often prohibitively expensive telephone service or satellite downlinks.

At the same time that urban areas enjoy unprecedented telecommunications options, the telephone services of some rural communities simply cannot dependably use electronic mail or computer

conferencing because they are on a party line or have low-quality service. Even when telephone service is adequate, electronic access to libraries and data bases and calls between students and teachers in rural areas may be impractical due to the high cost. Furthermore, the distribution pattern of the new technologies is generally market-driven, which means large urban populations receive priority over more sparsely populated rural areas.

Access to Computing. Lack of access to computers can be a more serious obstacle in distance education than on campus unless the student can handily use equipment at a local school, library, or the workplace, or has computer equipment at home. Lack of good quality software affects distance education as well as on- campus programs. Away from the campus, it is more difficult for the student to get help in learning how to use software or ironing out the bugs in hardware configurations. Like their colleagues on campuses, students may have difficulty with incompatibility of systems or lack of standards for data transmission and electronic communications.

■ *The distribution pattern of the new technologies is generally market-driven, which means large urban populations receive priority over more sparsely populated rural areas.*

Inadequate Software Design. Many technology-based programs were designed with the on-campus student in mind, so they may contain only partial lessons or lesson elements designed to be supplemented in the classroom or laboratory. Further, simulated laboratory programs are scarce, making the distance learner's inability to get to a laboratory a definite handicap in learning in those courses that assume that a laboratory experience will be available.

Support Service Complications. Students at a distance need most of the support services of on-campus students and then some. The fact that they are distant from the campus center makes providing these services even more difficult, further complicating the many handicaps that distant students often face.

Simple, basic training programs by telephone and mail to get distance learning students started can ultimately result in additional training by electronic mail or computer conferencing.

Structural Obstacles

A number of the structural obstacles encountered by distance educators stem from the fact that their activities and programs often challenge rules and regulations devised for campus-based instruction. State funding policies that are based on hours of face-to-face contact are an obvious example.

Need for Collaboration. Because technology does not respect the traditional boundaries of schools, colleges, states, or regions, distance learning often involves collaboration among many organiza-

tions. For example, establishing a statewide distance learning network may entail collaboration among educators from different institutions and sectors, as well as representation from business, government, and the communications industry.

For many in the education community, moving beyond traditional turf to address regional or statewide needs of distance learners can be difficult. Failure to adjust to these new circumstance can hinder effectiveness, rendering relatively worthless the technological advances that make modern-day distance learning possible. At the state level, there is an absence of integrated approaches to telecommunications and computing within state governments, making it difficult to put together collaborative systems that can stretch tight budgets and envelop higher education in a comprehensive statewide service.

■ *For many in the education community, moving beyond traditional turf to address regional or statewide needs of distance learners can be difficult.*

Transmission Across State Boundaries. Lack of policies dealing with facilitating the sharing of programming across state boundaries may hinder the delivery of effective services to students or may cause complications in out-of-state tuitions and similar practices which are often the subject of protracted negotiations where they apply to on-campus programs.

Access to Libraries. Off-campus students typically do not have equitable access to library systems, even though libraries increasingly offer totally automated services to students on-site.

Lack of Accessing Skills. Many off-campus students can access an increasing variety of commercial data bases, but they often lack the skills necessary to use them effectively. Further, no support or training is available to help these students learn how to use such systems

Attitudinal Obstacles

For most distance learning situations, the same attitudinal barriers exist that are found on campus. In addition, the following hurdles also are relevant:

Faculty Resistance to Public Exposure. To the extent that a faculty member's lecture suddenly becomes public, such as through TV broadcast, faculty members may resist the notion that they are suddenly being watched by non-students and casual viewers.

Faculty Resistance to Off-Campus Learning. Some instructors are simply resistant to dealing with students who cannot get to the campus, having little or no sympathy for the student whose life situation does not permit attending college in the traditional manner. Among these are teachers who believe they cannot teach if they "cannot see the students' faces," or who are reluctant to try interactive transmis-

sion systems that enable instructors to see students in classrooms located a distance from the campus. Some believe that "you can't teach this way," no matter what.

Unhealthy Marketing Orientations. Some educational institutions view technology as a vehicle to enhance marketing capability, principally to concentrated markets of professionals, even though the same or similar technology also could be used to reach target markets excluded from higher education for financial or geographical reasons. It is also ironic that some colleges and universities have found technology a useful vehicle to reach urban-centered professionals but not more isolated rural populations whose access to the campus is considerably more than a "time of day" problem.

■ *It is time to move from bewailing the obstacles to planning new practices, policies, and strategies...*

In spite of these and other obstacles to technology use, there are signs of genuine progress in the development of varying uses of technology in colleges and universities. A number of professors are exploring the use of a variety of technologies, some of whom are developing their own software. Academic support staff are rendering invaluable service to both faculty and students. Some institutions are planning and implementing programs utilizing technologies that are institution wide.

Yet despite these advances, the obstacles noted here continue to inhibit the broad use of technologies in colleges and universities. The obstacles are complex and inter-related. It is time to move from bewailing the obstacles to planning new practices, policies, and strategies that will encourage pilot developments, expand existing usages, and cooperate with the private sector, a partnership that should embrace not only the profit motive, but also the goals of education too.

The strategies to overcome these obstacles warrant our serious attention.